

STUDIES IN THE XYLARIACEAE:
VII. ANTHOSTOMELLA AND LOPADOSTOMA

P. MARTIN

(*Department of Microbiology, South African Institute for Medical Research.*)

The genus *Anthostoma* was based on *A. decipiens* (DC) Nits. and placed in the Valsaceae by Nitschke (1897, p. 110) and divided into two sections, *Euanthostoma* and *Lopadostoma*. In both groups the stroma was considered to be immersed, but diatrypeoid or eutypelloid and effuse in the former and valsoid or restricted in the latter. The oval or cylindric rather than allantoid shape of the spores, however, was later recognized to be a xylariaceous character by Wehmeyer (1926), Petrak (1928), Miller (1928) and Shear (1938), and consideration of this character together with the development of a carbonaceous "clypeus" or rudimentary external stroma led to its eventual removal to the Xylariaceae by the two latter authors.

Anthostoma was not accepted as a clearly defined genus. In 1906 Traverso distributed the species of *Anthostoma* between *Lopadostoma*, which he raised to generic level, and *Anthostomella*, a further genus erected by Saccardo in 1877.

They were distinguished as follows:

Anthostomella Saccardo (1877): Stromata uniperitheciate to multiperitheciate, effuse rather than pulvinate.

Lopadostoma (Nitschke) Traverso (1906): Stromata multiperitheciate, erumpent, valsoid.

Anthostoma thus became redundant, though still containing species that were not transferred to either of the new groups.

Structure of the stroma

The stroma is immersed and simple in both genera since each contains little or no pure fungal tissue beneath the perithecia, although much of the wood may be invaded. The entostroma encloses most of the perithecial area, and varies from corky to carbonaceous in texture, showing little if any differentiation. The spores are oval to elliptic or cylindric but never elongate.

Lopadostoma and *Anthostomella* are best compared in the following important respects:

	<i>Lopadostoma</i>	<i>Anthostomella</i>
Character		
Ectostroma	Comprises fungal tissue together with the outer layer of the substrate (bark or wood) that is shed or retained at maturity. The part retained becomes fused with and indistinguishable from the entostroma beneath. In <i>Lopadostoma</i> the ectostroma may be distinct (<i>L. turgidum</i>) but is usually discarded, so that stroma is erumpent and fully exposed at maturity.	In <i>Anthostomella</i> the ectostroma usually fuses with the carbonaceous entostroma; in some cases it is worn off to leave a somewhat truncate ostiolar apex.
Entostroma	Variable but characteristically massive, outer part forming a truncate cylinder (<i>L. apiculatum</i>) or pulvinate mass (<i>L. turgidum</i>).	Outer part typically apparent at maturity merely as a dull or shiny carbonaceous covering.
Ostioles	Tubular or not visible at stromal level, the former always produced above the perithecia and sometimes slightly curved or fluted.	Papillate, rarely tubular or indistinct; short and abrupt, rarely elongate; straight and smooth.
Asci	With flattened or discoid apical plug.	With cubic or oblong apical plug.
Spores	No appendiculate spores known.	Appendiculate spores frequent (section Entosordaria Sacc.).
Germ slits	Linear or poroid, on convex side of spore.	

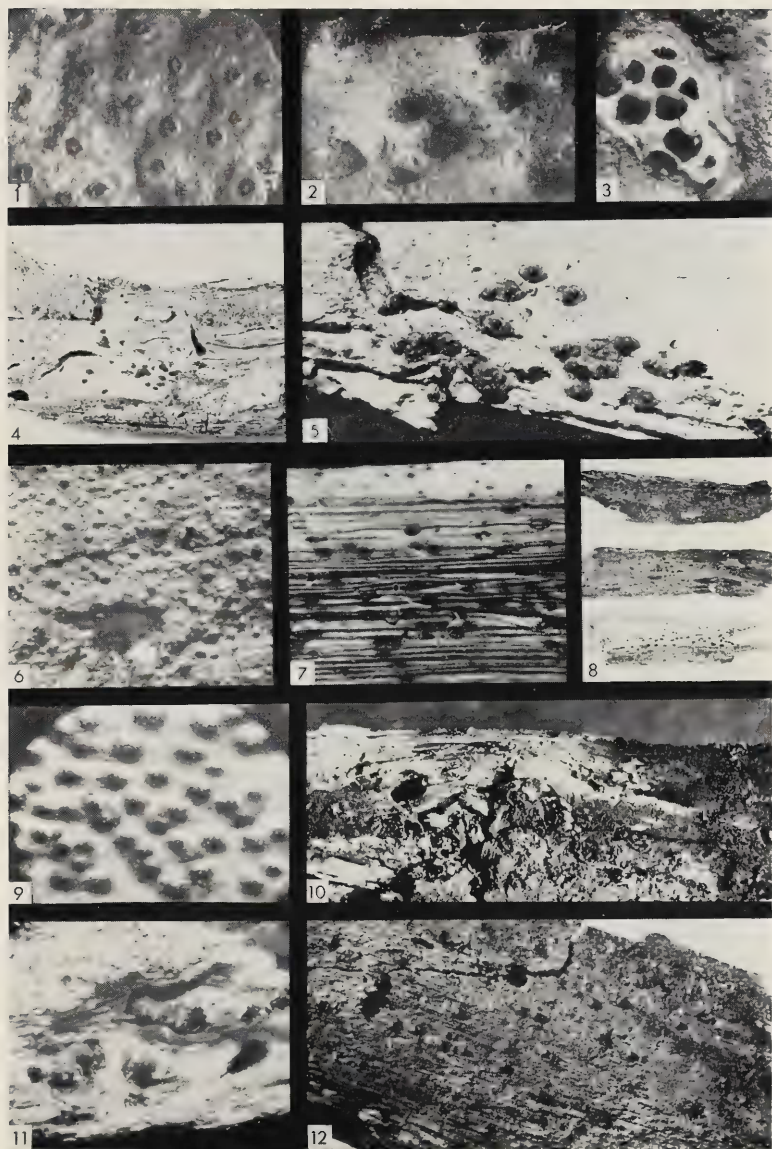
On these grounds the two genera are recognized as distinct. *Lopadostoma* shows affinity with *Numulariola* but has less differentiation. *Anthostomella* is connected to *Hypoxyylon* (Entoleuca) through *A. uda* and also by *H. geasteroides* in which the woody ectostroma scales off before maturity.

In the following keys several species have been reassigned according to the concepts of Saccardo and Traverso. The key covers those species in the New York Botanical Garden, and is representative but not complete. Until more information is available it is not considered wise to merge some species growing on monocotyledons with similar ones on dicotyledons, because there is some degree of host specialization apparent within these species.

Anthostomella.

Stromata permanently immersed, uni- or multiperitheciolate; irregularly globose, linear, pulvinate or aplanate, with ostioles projecting through the substrate that is often blackened or semi-carbonaceous; ascial plugs cubic or rectangular. Differs from *Hypoxyylon*: Entoleuca by immersion of stroma.

PLATE I. Stromata. 1. *Lopadostoma turgidum* $\times 1.25$. 2. *Lopadostoma sphinctinum* $\times 4$. 3. *Lopadostoma juglandinum*: horizontal section of stroma showing valsoid structure of erumpent stroma $\times 4$. 4. *Anthostomella alpigena* $\times 0.3$. 5. The same: $\times 2$. 6. *Anthostomella flavoviride* $\times 4$. 7. *Anthostomella ludoviciana* $\times 4$. 8, 10, 12. *Anthostomella melanotes*. 8. Stromata $\times 0.3$. 10. Young innate stromata with conidiophores and mycelia $\times 2$. 12. Mature stromata, fully erumpent $\times 2$. 9. *Anthostomella nitidissima* $\times 4$. 11. *Anthostomella protuberans* $\times 4$.



1. Spores appendiculate
.....(*Anthostomella*, sect. *Entosordaria* Sacc.).....2
- 1'. Spores not appendiculate.....10
2. Spores appendiculate on both ends.....3
- 2'. Spores appendiculate on one (proximal) end only.....4
3. Appendages obtuse, spores gibbous, broad-ended, medium to dark brown, $8.5 \times 18.5\mu$; stromata mainly immersed.
 Anthostomella italica (Sacc. & Speg.) Martin
 syn. *Anthostoma italica* Saccardo & Spegazzini
- 3'. Appendages attenuate, spores navicular, narrow-ended, pale brown, $5.5 \times 14.0\mu$; stromata evident in outline.
4. (2) Spores equilateral, dark brown.....5
- 4'. Spores inequilateral, pale brown.....9
5. On monocotyledonous hosts, including *Sabal*, spores narrow or broad-ended, $5.0-5.5 \times 12.5-13.0\mu$.
 Anthostomella sabalensioides Ellis & Martin
- 5'. On dicotyledonous hosts.....6
6. Ostioles tubular, conspicuous or partly buried in the wood, spores narrow-ended, $6.0 \times 14.0\mu$; wood often impregnated with white mycelium around the ostiole.
 Anthostomella albocincta Ellis & Everhart
- 6'. Ostioles papillate, or not conspicuous.....7
7. Spores oval to subglobose, broad-ended, $15.0 \times 22.0\mu$.
 Anthostomella umbrinella (DN.) Saccardo
- 7'. Spores elliptic.....8
8. Spores broad-ended, $8.0-9.5 \times 20.0-20.5\mu$; stromata globose conic; perithecia evident with prominent papillate shiny ostioles.
 Anthostomella poetschii Niessl
- 8'. Spores acute-ended, $8.5-9.0 \times 23.5-26.0\mu$; stromata conic; perithecia vaguely evident; ostioles dull, surrounded by truncate collar of carbonous substrate.
 Anthostomella appendiculosa (B. & Br.) Saccardo
9. (6) Spores gibbous, narrow-ended, $3.5-5.0 \times 8.5-10.5\mu$; stromata minute, gregarious, globose, shiny.
 Anthostomella clypeata (DN.) Saccardo
- 9'. Spores navicular, broad-ended, $6.0 \times 13.0\mu$; stromata not aggregated, conic, dull.
 Anthostomella tomicoides Saccardo
10. (1) Stromata minute, about $50-100\mu$ diameter, substrate scarcely darkened.
 (*Anthostomella*, section *Desciscentes* Saccardo).....11
- 10'. Stromata exceeding 100μ in diameter, substrate usually conspicuously darkened
 (*Anthostomella*, sect. *Euanthostomella* Saccardo).....17
11. Spores globose to broad oval, equilateral.....12
- 11'. Spores oval to elliptic.....13
12. Spores dark brown, $7.0 \times 10.0\mu$; on leaves
 Anthostomella pisana (Pers.) Saccardo
- 12'. Spores black, $13.0 \times 16.5\mu$; on stems
 Anthostomella coryphae Rehm
13. (11) Spores equilateral, narrow-ended, pale brown $4.5 \times 11.5\mu$; stromata pustulate or blisteriform.
 Anthostomella leucobasis Ellis & Morgan
- 13'. Spores medium to dark brown; stromata otherwise.....14
14. Spores equilateral, dark brown.....15
- 14'. Spores gibbous to navicular, medium to dark brown.....16
15. Spores acute-ended, $7.0 \times 13.0\mu$; stromata inconspicuous, not markedly gregarious.
 Anthostomella microsticta Ellis & Everhart
- 15'. Spores broad-ended, $5.5 \times 11.0\mu$; stromata gregarious with shiny black ostioles.
 Anthostomella palmicola (Awd.) Rabenhorst
16. (14) Spores gibbous, narrow-ended, dark brown, $8.0-8.8 \times 18.5-22.5\mu$; stromata gregarious but not shiny.
 Anthostomella melanosticta Ellis & Everhart
- 16'. Spores gibbous to navicular, broad-ended, medium brown, with poroid germ slits, $3.5-4.0 \times 6.5-9.0\mu$; stromata usually inconspicuous, sometimes a few adjacent but not generally gregarious.

- Anthostomella phaeosticta* (B. & Br.) Saccardo
syn. *Anthostomella madeirensis* Petrak
Anthostomella pandani (Rab.) Rehm.
17. (10) Stromata with one or a few perithecia, never taking the form of an indefinite crust; not containing more than 5 perithecia and rarely exceeding 4 mm long. 18
- 17'. Stromata with several perithecia united by a superficial carbonaceous crust or clearly gregarious; some stromata at least 3.5 mm long and/or containing 6 perithecia. 40
18. Spores equilateral, narrow-ended, colourless, hyaline, with thick transparent sheaths, $15.5 \times 38.0 \mu$.
Anthostomella rhizomorphae (Kutz.) Berl. & Vogl. 19
- 18'. Spores with some degree of colouration. 19
19. Spores equilateral, broad-ended, dark brown with equatorial band paler than the peripheral areas, $8.5 \times 16.0 \mu$.
Anthostomella bicincta Sydow 20
- 19'. Spores concolorous. 20
20. Germ slits poroid at each end of spore; spores gibbous to broad crescentic, broad-ended, dark brown, $11.0-12.0 \times 30.0 \mu$.
Anthostomella uda (Pers. ex Fr.) Martin nov. comb.
Hypoxylon udum Persoon ex Fries 21
- 20'. Germ slits straight linear. 21
21. Stromata with setose or subiculate bases; spores equilateral, broad-ended, dark brown, $10.0 \times 16.5 \mu$.
Anthostomella mindorensis Rehm 22
- 21'. Stromata glabrous. 22
22. Stromata uniperitheciate, merely forming a circular area of darkened substrate around each ostiole; spores equilateral, broad-ended, pale brown, $7.5 \times 16.0 \mu$.
Anthostomella elmeri Sydow 22
- 22'. Stromata hemispherical, 1-3 peritheciate; exterior crust formed of stroma alone or with carbonized bark, often with shiny surface; spores equilateral, broad-ended, pale brown; $13.0 \times 26.5 \mu$.
Anthostomella calocarpa Sydow 22'
- 22' '. Stromata 1-3 peritheciate, raised into an exterior oval plaque around each ostiole; ostioles truncate due to splitting away of the bark; spores equilateral, narrow-ended, dark brown, $6.0 \times 13.5 \mu$.
Anthostomella discophora Sydow 23
23. External stroma around the ostioles not as above, irregular in outline or reduced. 23
- 23'. On monocotyledonous hosts. 24
- 23'. On dicotyledonous hosts. 30
24. Spores light brown. 25
- 24'. Spores medium brown to nearly black. 26
25. Spores equilateral, broad-ended, amber to pale brown, $3.0 \times 6.0 \mu$, conic, immersed or evident in outline; ostioles papillate but not conspicuous; on stems.
Anthostomella ludoviciana Ellis & Langlois (Plate I:7) 25'
- 25'. Spores navicular, narrow-ended, medium to dark brown, $4.5 \times 11.5 \mu$; perithecia immersed completely though surrounded by black carbonized substrate; ostioles papillate; on leaves.
Anthostomella miscanthea Saccardo 27
26. (24) Spores equilateral. 27
- 26'. Spores inequilateral, gibbous. 29
27. Stromata rather small, 100-300 μ in diameter and immersed in the substrate; on *Yucca*, possibly specific for this. 28
- 27'. Stromata usually longer than 300 μ in diameter, and evident to some degree, sometimes like blisters; hosts various but not including *Yucca*; spores acute-ended, dark brown, $6.0 \times 12.0 \mu$.
Anthostomella contaminans (D. & M.) Saccardo
syn. *Anthostomella sepebilis* (B. & C.) Saccardo 28
28. Spores broad-ended, dark brown, $5.0 \times 9.0 \mu$.
Anthostomella yuccae von Thumen 28'
- 28'. Spores broad-ended, dark brown to black, $8.5 \times 17.0 \mu$.
Anthostomella nigroannulata Berkeley & Curtis 28'

29. (26) Stromata immersed or evident in outline as conic protuberances; spores gibbous, narrow-ended, dark brown, $7.5 \times 20.5\mu$.
Anthostomella tumulosa (Rob.) Rabenhorst.
29. Stromata immersed, carbonization somewhat restricted or nearly absent; spores gibbous, broad-ended, medium to dark brown, $9.5-10.0 \times 20.5-23.0\mu$.
Anthostomella lugubris (Rob.) Saccardo
 syn. *Anthostomella ammophila* Phil. & Plowright
Anthostomella calamagrostidis Brun.
30. (23) Spores uniformly light brown.....31
- 30'. Spores medium to dark brown or varying from light to dark within the same sample.....33
31. Spores equilateral.....32
- 31'. Spores navicular to broad crescentic, narrow-ended, $5.0 \times 13.0\mu$; perithecia immersed completely, carbonized substrate minimal; ostioles tubular papillate and projecting from woody substrate.
Anthostomella protuberans Martin nov. sp.
32. Spores equilateral, narrow-ended, $3.5 \times 9.0-9.5\mu$; perithecia immersed or vaguely evident, up to 10 in a flat crustose stroma; ostioles papillate, sometimes definitely sulcate.
Anthostomella inconspicua Martin nov. comb.
 syn. *Anthostoma picaceum* (C. & E.) Ellis & Everhart.
- 32'. Spores broad-ended, $5.5 \times 20.0\mu$; perithecia immersed, only ostioles visible as small dots surrounded by carbonized substrate.
Anthostomella cavarica (Petrak) Martin
 syn. *Anthostoma cavaricum* Petrak.
33. (30) Spores inequilateral, gibbous.....34
- 33'. Spores equilateral; or when slightly gibbous, stromata without prominent papillate ostioles.....35
34. Spores gibbous, broad-ended, $5.5-6.0 \times 12.0-13.0\mu$; perithecia immersed with only the ostioles evident, though wood strongly discoloured.
Anthostomella schmidtii (Auersw.) Martin
 syn. *Anthostoma schmidtii* (Auersw.) Nitschke
- 34'. Spores gibbous, broad to narrow-ended, $7.0 \times 20.5\mu$.
Anthostomella helichrysi Fabricius
35. Spores broadly oval to subglobose; stromata prominent with perithecia evident in outline.....36
- 35'. Spores elliptic; stromata not conspicuous if spores are somewhat broad in relation to length.....37
36. Spores broad-ended, $6.5 \times 10.5\mu$.
Anthostomella vaga Niessl
- 36'. Spores broad-ended, $7.5-10.0 \times 13.5-14.5\mu$.
Anthostomella alpigena (Fckl.) Martin
 syn. *Anthostoma alpigenum* (Fckl.) Saccardo
37. (35) Spores narrow-ended, $5.5-9.0 \times 10.5-16.0\mu$; stromata minute to small, uniperitheciate, immersed except for minute projecting ostioles or perithecial vertices clearly evident, conical.
Anthostomella melanotes (B. & Br.) Martin
 syn. *Anthostoma melanotes* (B. & Br.) Saccardo
- 37'. Spores broad-ended, or if narrow then much longer.....38
38. Spores $6.0 \times 12.5\mu$; stromata 1-4 peritheciate, distinct, ostioles usually strongly papillate.
Anthostomella ostiolata Ellis & Everhart
- 38'. Spores $6.0 \times 12.0\mu$; stromata uniperitheciate, mostly immersed; ostioles shiny, conic, tubular to inconspicuous.
Anthostomella eructans Ellis & Everhart
- 38''. Spores larger.....39
39. Stromata small with variable degree of immersion, carbonized substrate minimal to pronounced, spores broad or narrow-ended, $6.5-9.5 \times 13.0-16.5\mu$.
Anthostomella xylostei Saccardo
 syn. *Anthostoma mortuosa* Ellis
- 39'. Stromata small but shiny; spores larger, broad-ended, $7.5-10.5 \times 19.0-22.5\mu$.

- Anthostomella sustenta* (Plow.) Martin
syn. *Anthostoma sustentum* (Plow.) Saccardo
40. (17) Spores hyaline, almost colourless, cylindric, broad-ended, $7.5 \times 14.0 \mu$.
Anthostomella ratibidae Solheim
- 40'. Spores some distinct shade of brown. 41
41. Perithecia clearly evident in outline. 42
41'. Perithecia completely immersed in the stroma. 44
42. Spores equilateral to gibbous, broad-ended, dark brown, $9.5 \times 19.0 \mu$; stromata free of substrate at maturity, somewhat shiny.
Anthostomella hypsophila Ellis & Everhart
- 42'. Spores narrow-ended, smaller; stromata at least partially covered by substrate. . 43
43. Spores gibbous to navicular, narrow-ended, dark brown, $5.0-8.0 \times 13.0-15.5 \mu$; carbonous matrix sometimes shiny.
Anthostomella tomicum (Lév) Saccardo
syn. *Anthostomella lucens* Saccardo
- 43'. Spores gibbous to navicular, narrow-ended, pale to dark brown, $3.5-4.0 \times 7.5-8.5 \mu$; carbonous matrix dull; ostioles often annulate after removal of substrate.
Anthostomella nitidissima (D. & M.) Saccardo (Plate I:9)
syn. *Anthostomella cocoina* Sydow
Anthostomella minor Ellis & Everhart
Anthostomella sacchariferae Rehm
- 43''. Spores equilateral to gibbous, narrow-ended, amber to pale brown, $6.0 \times 14.5 \mu$; stromata immersed though evident in outline, dull.
Anthostomella sphaerotheca Earle
44. (41) Stromal surface black, spores navicular, crescentic to allantoid, narrow-ended, pale brown, $4.0 \times 10.5 \mu$.
Anthostomella picacea Saccardo
- 44'. Stromal surface faint olive green, granulate; spores equilateral, narrow-ended, medium brown, $4.5 \times 11.0 \mu$.
Anthostomella flavoviride (E. & H.) Martin (Plate I:6)
syn. *Anthostoma flavoviride* Ellis & Holway.

Lopadostoma.

Stroma innate but irregularly erumpent, valsoid, circular, linear or pulvinate; perithecia several, close packed, often with long necks; ostioles sessile to tubular; substrate not conspicuously altered by fungus; ascus plugs discoid or flattened. Differs from *Numulariola* in vestigial ectostroma and smaller size.

1. Ostiolar mouths white, sometimes also surrounded by a white mycelial invasion of the wood; ostioles smooth and tubular in form. 2
2. Ostiolar mouths black, without trace of white mycelium; ostioles smooth or sulcate, beaked, tubular or sessile. 3
2. Spores equilateral, broad-ended, medium to dark brown, $9.5 \times 15.5 \mu$.
Lopadostoma cubiculare (Fr.) Martin
syn. *Anthostoma cubiculare* (Fr.) Nitschke
- 2'. Spores equilateral, acute-ended, dark brown, $11.0 \times 17.5 \mu$.
Lopadostoma stictoides (E. & E.) Martin
syn. *Anthostoma stictoides* Ellis & Everhart
- 2''. Spores equilateral to gibbous, acute-ended, medium to dark brown, $11.0 \times 27.5 \mu$.
Lopadostoma ostropoides (Rehm) Martin
syn. *Anthostoma ostropoides* Rehm
3. (1) Ostioles beaked and very conspicuous; stromata often in linear groups. 4
- 3'. Ostioles sessile to tubular but rarely conspicuous. 6
4. Ostioles sulcate, similar to those of *Diatrype*; spores equilateral, broad-ended, pale to medium brown, $3.5 \times 7.5 \mu$.
Lopadostoma decipiens (DC.) Martin
syn. *Anthostoma decipiens* (DC.) Nitschke
- 4'. Ostioles entire, not divided. 5
5. Spores equilateral, broad-ended, medium to chestnut brown, $8.5-9.5 \times 19.0-23.5 \mu$.

- Lopadostoma apiculatum* (Currey) Martin
syn. *Anthostoma apiculatum* (Currey) Nitschke
- 5'. Spores equilateral, broad-ended, medium to dark brown, $4.0 \times 11.0 \mu$.
Lopadostoma formosum (E. & E.) Martin
syn. *Anthostoma formosum* Ellis & Everhart
6. (3) Stromata forming a conspicuous erumpent shallow concave to pulvinate, circular to oblong crust (clypeus) above the perithecia.12
- 6'. Stromal material not greatly developed above the perithecia; stromata circular (hypoxylod) or linear (diatrypeoid)7
7. Stromata circular (hypoxylod)8
- 7'. Stromata linear (diatrypeoid) appearing through cracks in the substrate.9
8. Stromata with several narrow perithecia packed as in *Numulariola*; ostioles sessile, indistinct; spores cylindric or clearly so, amber, subhyaline, $2.5 \times 5.0-5.5 \mu$.
Lopadostoma microsporum (Karst.) Martin
syn. *Anthostoma microsporum* Karsten
- 8'. Stromata 1—2 peritheciate; ostioles indistinct papillate; spores broad oval, equilateral, medium brown, $6.0 \times 9.0 \mu$.
Lopadostoma conorum (Fckl.) Martin
syn. *Anthostoma conorum* (Fckl.) Saccardo
Anthostomella pholidigena Ellis
9. (7) Spores amber, hyaline, equilateral, elliptic to cylindric, broad-ended, $3.0 \times 5.0 \mu$; perithecia large, $700-800 \mu$ in diameter, usually grouped in linear or crescentic pattern.
Lopadostoma helvetica (Fckl.) Martin
syn. *Anthostoma helvetica* Fuckel
- 9'. Spores pale brown or darker, translucent to opaque10
10. Spores fusoid, narrow or acute-ended, medium to dark brown, $9.5 \times 22.0 \mu$.
Lopadostoma rhenanum (Fckl.) Martin
syn. *Anthostoma rhenanum* (Fckl.) Rabenhorst
- 10'. Spores broad-ended11
11. Spores equilateral, dark brown, $3.5 \times 6.5 \mu$.
Lopadostoma microecium (E. & E.) Martin
syn. *Anthostoma microecium* Ellis & Everhart
- 11'. Spores equilateral, medium brown, $4.0 \times 9.0-9.5 \mu$.
Lopadostoma juglandinum (Rehm) Martin (Plate I:3)
syn. *Anthostoma juglandinum* Rehm
- 11' '. Spores equilateral, dark brown, $7.5 \times 13.0 \mu$.
Lopadostoma caespitosum (E. & E.) Martin
syn. *Rosellinia caespitosa* Ellis & Everhart
12. (6) Clypeus irregular in form, at the same time level as the bark or slightly concave beneath it; spores equilateral, broad-ended, dark brown, $3.5 \times 9.0-5.5 \times 10.0 \mu$.
Lopadostoma turgidum (Pers.) Traverso (Plate I:1)
- 12'. Clypeus convex, pulvinate or hemispheric, usually raised above the substrate level13
13. Clypeus usually hemispheric though sometimes pulvinate, ostioles conic to indistinct; spores $3.5-4.0 \times 9.0-9.5 \mu$.
Lopadostoma sphinctinum (Fr.) Martin (Plate I:2)
syn. *Anthostoma sphinctina* (Fr.) Saccardo
Anthostoma dryophilum (Curr.) Saccardo
- 13'. Clypeus pulvinate, ostioles characteristically tubular though sometimes very short; spores equilateral, narrow-ended, medium brown, $3.5-5.0 \times 10.0-11.0 \mu$.
Lopadostoma gastrinum (Fr.) Traverso

Species Description:

It is unfortunate that only a few species of *Anthostomella* and no species at all of *Lopadostoma* were able to be cultured. The species of *Anthostomella* are interesting however in that they relate well with the section *Entoleuca* of *Hypoxylon*, in regard to their conidiophores.

1. ***Anthostomella melanotes*** Saccardo. (Fig. I:2, Plate I:8, 10, 12, Plate III:1—3)

Ellis J. B. & B. M. Everhart Jour. Mycol. 3, 44, (1887); N. Amer. Pyren. 48, (1892).
Traverso J. B. Flora Ital. Crypt. I, 176, (1906).

Stromata aplanate on decorticated wood with the major part immersed in the substrate, discoid to oval, $0.3\text{--}0.8 \times 0.3\text{--}2.4 \times 0.3\text{--}1.1$ mm. Ectostroma mixed with wood and not discernible at maturity; outer entostroma carbonaceous, superficial, surrounding apices of perithecia; basal tissue not well developed and not extending far beyond the perithecial bases; host wood not infected by mycelium to any marked degree. Perithecia 1–3 per stroma, globose to coniform, $200\text{--}700 \times 200\text{--}1,000\mu$; ostioles medium papillate. Asci clavate, long stipitate, $120\text{--}130 \times 9\mu$; stipes $70\text{--}75\mu$. Spores oval, equilateral to gibbous, with prominent gelatinous sheaths, light to dark brown, $4.5\text{--}9.5 \times 8.0\text{--}16.5\mu$, ave. $6.7 \times 12.9\mu$.

South African hosts: *Canthium spinosum* and wood unidentified.

Material examined:—

Martin 12, 75, 103, 147, 149, 349, 429, 432, 436, 536, 568, 569, 570, 572; Nature's Valley, Knysna District, Western Cape, South Africa (1958, 1959). Mason in Herb IMI 45311; on *Ulmus*, Rewell wood, Arundel, England, (1939), (NYBG).

Cultural characters (Plate II:3—4):

Colonies mainly velvety, sometimes velvet felty but with smooth surface, forming a closely appressed mat on the agar surface. Growth is uniform or zonate, 6 zones each 3 mm wide and 7 mm apart being formed in 4 weeks at $20\text{--}25^\circ\text{C}$. After 2 months in bottle culture, scattered floccose dull white to pale grey outgrowths are formed which are similar to those of *A. alpigena*, and the initial zonate pattern is obscured. Margin not distinct, entire, compact hyphae lying closely parallel. Conidia appear after 7 days as a thin white fawn or very pale grey covering over the centre of the colony. Stain and carbonization absent. Growth rate slow, 0.6 mm/day at 25°C . Growth on other media similar except on Czapek where growth is uniform, submersed initially and later canescent.

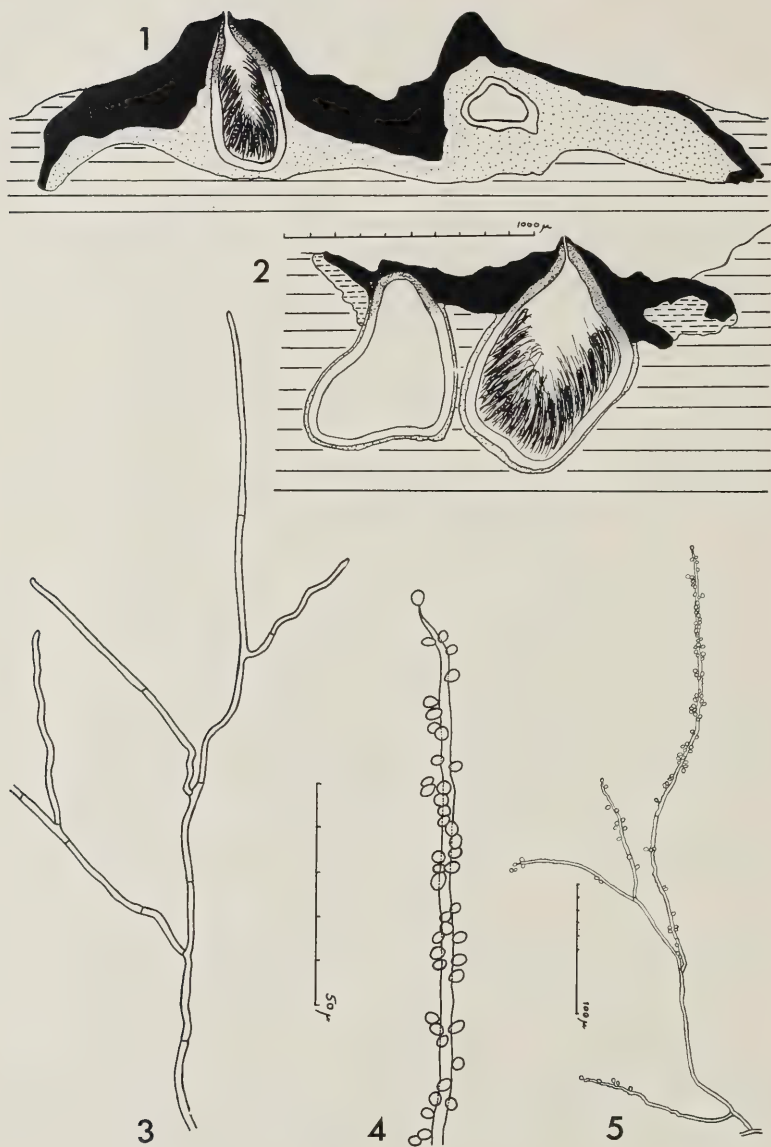
Microscopic characters:

Primary mycelium undiagnostic; marginal hyphae rather narrow, up to 1.7 mm in diameter. Secondary mycelium absent.

Imperfect stage (Plate III:4). See also Martin (1967), p. 226, fig., 4.

Traverso J. B. Flora Ital. Crypt. I, 172, (1906).

The conidiophores and conidia correspond to the *Nodulisporium* type IIa, comprising long indefinite systems with dichotomous branching, $300\text{--}500 \times$



1.5—2.0 μ . Fertile branches are geniculate, lying freely, usually nonseptate but with up to 2 septae; 85—100 $\times$ 1.5—2.0 μ . The upper 9—20 μ of the fertile branches bear conidia in dense spicate clusters, each conidium on a wart like prominence. The conidia are subglobose to oval with wide truncate bases, pale fawn grey en masse, 1.4—2.6 $\times$ 2.3—4.0 μ , ave 1.8 $\times$ 3.0 μ .

2. *Anthostomella alpigena* (Fckl.) Martin nov. comb. (Fig. I:1, Plate I:4, 5).

sub *Amphisphaeria alpigena* Fuckel.

Fuckel L. Symb. Myc. Nachtrag I, 16, (1871).

sub *Anthostoma alpigenum* (Fckl.) Sacc.

Bizzozero G. Flora veneta critt. 1, 196, (1885); Rabenhorst L. Kryptogamenflora II, 755, (1887). Saccardo P.A. Atti. Soc. Ven. Trent. 4, 95, (1875); Fungi Italici 161, (1877—1886); Syll. Fung. I, 301, (1882). Traverso J. B. Flora Ital. Crypt. I, 178. (1906).

Stromata aplanate on decorticated wood, with a clearly defined orbicular or linear carbonized entostromal area surrounding each characteristically conic perithecial vertex; 2.0—5.6 $\times$ 4.0—12.0 $\times$ 0.7—0.8 mm. Perithecia 1—3 per stroma, 200—300 $\times$ 600—700 μ ; ostioles papillate. Asci clavate, 110—150 $\times$ 6—10 μ . Spores broadly oval to subglobose, dark brown, 4.5—10.0 $\times$ 9.0—19.5 μ ; ave 8.9 $\times$ 13.8 μ .

South African hosts: *Acacia cyclops*, *Sideroxylon inerme*.

Material examined:—

sub *Anthostoma alpigenum*

Berlese in Saccardo's Mycotheca Italica 1289; on *Lonicera caprifolia*, Sassari, Sardinia, (1901), (NYBG). Gelbenegger 1722; on *Lonicera xylostei*, Ybbsitz, Austria, (date ?), (NYBG).

sub *Anthostoma mortuosa*

Ellis on *Polygonum*, Newfield, N.J., U.S.A., (1888), (NYBG).

sub *Anthostomella alpigena*

Martin 257, 529; Kenton-on-Sea, Eastern Cape, South Africa, (1958, 1959). Martin 1004; Nature's Valley, Knysna District, Western Cape, South Africa, (1962).

Cultural characters (Plate II:1—2, 5—9):—

Colonies at first coarse felty with dense white aerial mycelium up to 0.3 mm high, later floccose with a coarse surface and developing grey flaring sterile mycelial aggregates 2—15 mm long, near the original point of inoculation or scattered over most of the colony. The aerial mycelium is white, sometimes turning very pale cream or orange with age. Growth is uniform in plate culture but zonate inside bottles, 6 zones 3 mm wide developing by a month. With age

FIG. I. 1—2. Vertical sections through Stroma. Solid black: carbonous entostroma. Fine lines: carbonized perithecial wall. Blank: soft perithecial wall. Stippling: corky basal tissue. Interrupted lines: fungal invasion of wood. Solid lines: host wood. 1. *Anthostomella alpigena*. 2. *Anthostomella melanotes*. 3—5. *Anthostomella alpigena*: microscopic characters. 3. Marginal hypha. 4. *Nodulisporium* type I conidiophore: detail of fertile branch. 5. The same: whole conidiophore.

a distinct rind 1.5 mm thick is formed in the substrate but there is no carbonization. The margin is distinct, submersed, 2—3 mm broad, usually uneven and segmented due to compact or effuse growth of the hyphae in different directions. Conidia are produced with age, after 6 months in bottle culture, very finely granulate and pale fawn in colour. Stain appears after 2—3 weeks, faint ochre yellow and diffuse throughout the substrate, also exuded as droplets on the mycelial surface. Growth is slow, 1.9 mm/day at 25°C.

Growth on other media is similar but much less luxuriant on Czapek.

Microscopic characters (Fig. 1:3):—

Primary mycelium rather narrow, marginal hyphae with a maximum diameter of 1.7 μ . Secondary mycelium absent.

Conidiophores and conidia (Fig. 1:4, 5):—

This species has one of the least specialized types of conidiophore so far observed in the Xylariaceae, corresponding to *Nodulisporium* type I. They are scarcely distinct from the vegetative mycelium but are extremely long, 500—700 $\times$ 2.0—2.5 μ , dichotomously branched to the second degree or indefinitely. Fertile branches irregular in outline but not definitely geniculate, 96—340 $\times$ 2.0—2.5 μ . Conidia produced apparently at random from all over the axes, either simply or in groups of 2—3, sessile, oval to subglobose with narrow bases, tinted pale yellow or fawn en masse, 1.7—3.2 $\times$ 2.6—3.4 μ , ave. 2.4 $\times$ 3.2 μ .

3. *Anthostomella xylostei* (Saccardo) Martin nov. comb.

sub *Anthostoma mortuosa* Ellis J. B. Bull. Torrey Bot. Club 9, 73, (1882).

sub *Anthostoma xylostei* Saccardo

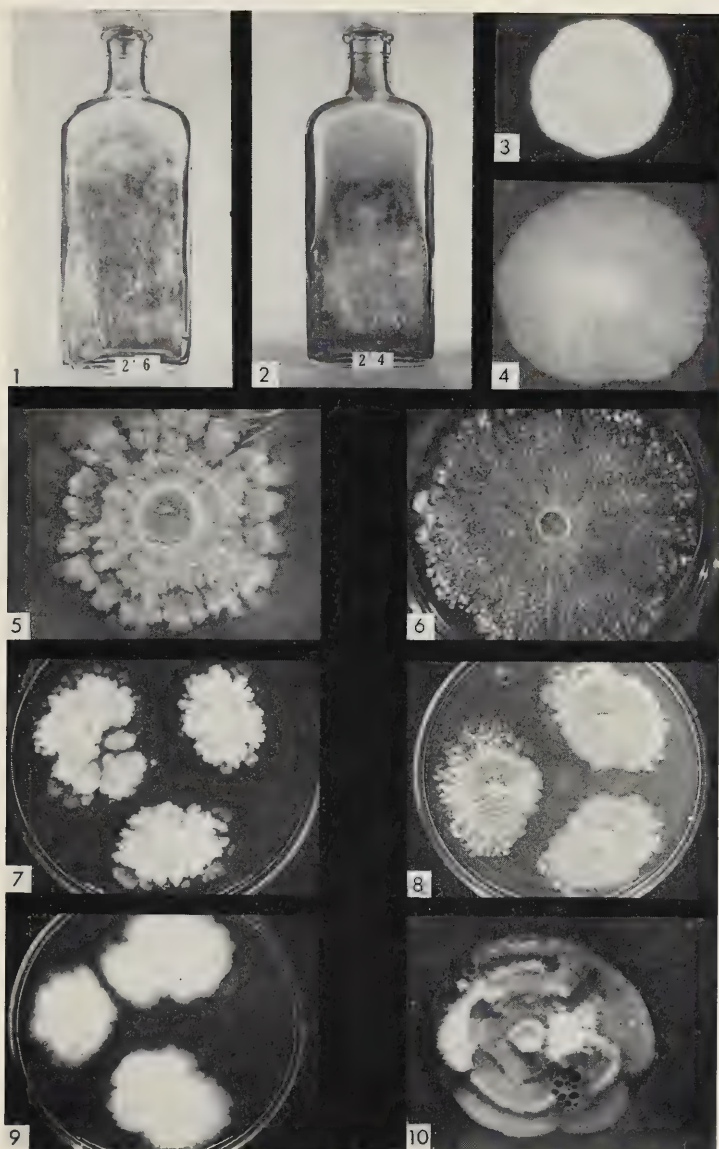
Bizzozero G. Flora veneta critt. 1, 196, (1885). Dennis R.W.G. British Cup Fungi 176, (1960). Kickx J. Recherches à la flore crypt. de Flanders V, 19, (1885). Rabenhorst L. Krypt. flor. Deutsch. II, 755, (1887). Rehm. H. Berichte Naturh. Vereins Augsburg. 26, 14, (1881). Saccardo P.A. Fungi Ital. 162, (1877—1886); Syll. Fung. I, 300, (1882). Schroter J. in Cohn: Kryptoflor. Schlesien 433, (1908). Starbäck K. Bih. Svenska Vet. akad. Handl. 15, 8, (1889). Strassen P. Ann. Mycol. 9, 91, (1911). Traverso J. B. Flora Ital. Crypt. I, 177, 1906.

sub *Sphaeropsis xylostei* Petrak & Sydow.

Petrak F. & H. Sydow. Ann. Mycol. 22, 335, (1924).

Stromata globose, discoid or irregular, with up to 5 perithecia, 0.5—1.0 $\times$ 0.6—2.8 $\times$ 0.7—0.9 mm. Ectostroma not apparent, entostroma similar to but

PLATE II. Cultural characters. All 14 days old at 25°C unless otherwise stated. 1—2. *Anthostomella alpigena*; bottle cultures. 1. Malt agar. 2. Leonian's agar. 3—4. *Anthostomella melanotes*; plate cultures. 3. Malt agar. 4. Maize agar. 5—9. *Anthostomella alpigena*; plate cultures. 5, 6. Malt agar, 14 and 28 days old. 7. Leonian's agar. 8. Maize agar. 9. Czapek agar. 10. *Anthostomella sabalensioides*; malt plate.



more restricted in quantity than in *A. alpigena*, comprising a small carbonized area around each ostiole and a scant degree of dull brown to black corky basal tissue. Perithecia evident at vertices to completely immersed, globose, sometimes with conic vertices, $400-700 \times 600-800 \mu$; ostioles tubular or medium papillate. Asci cylindric, $130-190 \times 8-16 \mu$; stipes $10-90 \mu$. Spores broad oval to elliptic, equilateral to gibbous, with broad or narrow ends, dark brown brown, $6.0-11.5 \times 11.0-19.0 \mu$, ave. $8.4 \times 14.6 \mu$.

Material examined:—

sub *Anthostoma mortuosa*

Ellis ?; on *Vitis*, Newfield, N.Y., U.S.A., (1882), (NYBG). Ellis N. Amer. Fungi 897; on *Eupatorium* and *Andropogon*; Newfield, N.J., U.S.A., (NYBG).

sub *Anthostoma xylostei*

Allescher & Schnabl's Fungi bavarici 251; on *Lonicera nigra*, Oberammergau, Germany, (1892), (NYBG). Desmazières 1768; on *Lonicera xylostei* (? details), (NYBG). Fautrey in Roumeguère's Fungi selecti exsicc. 6102; on *Lonicera periclymenum*, Côte d'Or, France, (1892), (NYBG). Rehm's Ascomyceten 41B; on *Lonicera xylosteum*, Oberbayern, Germany, (1908), (NYBG).

sub *Anthostomella xylostei*.

Martin 585; Fernkloof, Grahamstown, E. Cape, South Africa, (1960). Martin 758, 761; O'Brien, N. Calif., U.S.A., (1961).

Cultural characters:—

Colonies felty, uniform, growing freely with fine texture, pure white; mycelial aggregates absent. Margin not distinct, entire, hyphae lying together. Conidia formed when old, not conspicuous. Stain and carbonization absent. Growth rate slow, 1.8 mm/day at 25°C .

Microscopic characters:—

Primary mycelium narrow; maximum diameter of the marginal hyphae = 1.5μ . Secondary mycelium absent.

Conidiophores and conidia (Plate III:5, 8):—

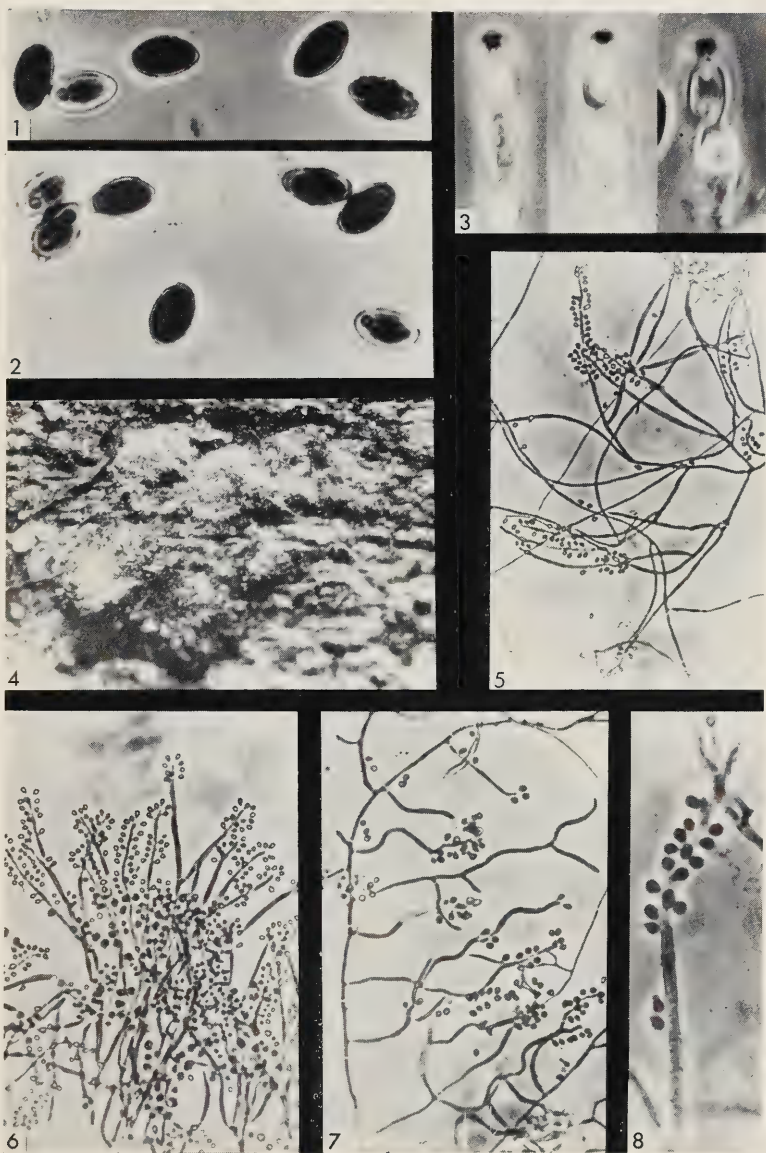
Conidiophores similar to those of *A. alpigena* in indefinite dichotomous branching but more clearly distinct on account of shorter length and geniculate fertile branches (*Nodulisporium* IIa); $180-240 \times 1.2-1.3 \mu$. Fertile branches lying freely, $37-120 \times 1.2-1.3 \mu$. Conidia pleuracrogenous or arising all over the axes, sessile, broad clavate, pale grey en masse, $1.8-1.9 \times 2.5-3.1 \mu$, ave. $1.9 \times 2.8 \mu$.

PLATE III. Microscopic characters.

1—4. *Anthostomella melanotes*. 1, 2. Spores with linear germ slits and prominent gelatinous sheaths, latter disintegrating in some cases. $\times 675$. 3. Young asci with cubical ascal plugs. Iodine stain. $\times 675$. 4. Surface view of prominent conidial mats on wood and on ostiolar mouths. $\times 12.5$.

5, 8. *Anthostomella xylostei*. 5. Conidiophores. $\times 270$. 8. Detail of above. $\times 675$.

6, 7. *Anthostomella protuberans*. Compact and dendroid conidiophores. $\times 270$.



4. *Anthostomella protuberans* Martin nov. sp. (Plate I:11)

Stromata in ligno mortuo; perithecia innata, solum ostiola cylindrica extantes; sporae navicularae, pallidae fuscae, medius $4.9 \times 12.9\mu$.

Stromata globose to discoid or irregular, with up to 4 perithecia, $1.1-1.2 \times 1.2-3.0 \times 1.6$ mm. Ectostroma and carbonous entostroma very slightly developed, dull brown, leaving the ostioles as virtually the only part of the stroma above substrate level, basal tissue slight, black. Perithecia vaguely evident to completely immersed, globose to oval, rather large, $1,100-1,500 \times 1,500-1,700\mu$; ostioles elongate, distinctly tubular and conspicuous in side-view. Asci not seen. Spores navicular to crescentic, ends narrow rounded, pale brown, with prominent sheaths $3.5-5.5 \times 11.0-14.5\mu$, ave. $4.9 \times 12.9\mu$.

Material examined:—

Martin 1174; Lake Ozark, Mo., U.S.A., (1962).

Cultural characters:—

Colonies canescent, appressed, uniform, colourless to white sub-hyaline, without mycelial aggregates. Margin not distinct, entire; hyphae lying compactly. Conidia formed immediately as in *Hypoxylon serpens* and *H. ludovicianum* (*Hypoxylon* section *Entoleuca*). Stain and carbonization absent. Growth rate exceedingly slow, 0.1 mm/day at 25°C.

Microscopic characters:—

Primary mycelium narrow, undiagnostic; maximum diameter of marginal hyphae = 1.2μ . Secondary mycelium absent.

Conidiophores and conidia (Plate III:6, 7):

Conidiophores corresponding to *Nodulisporium* type IIa; similar to the vegetative mycelium, $90-230 \times 1.2-1.5\mu$, dichotomously branched distally to the first or second degree. Fertile branches irregular to regularly geniculate, lying freely, $18-67 \times 1.8-2.5\mu$. Conidia pleuracrogenous, not borne randomly, sessile, subglobose, broad based, fawn brown en masse, $1.8-3.7 \times 2.7-3.7\mu$, ave. $2.8 \times 3.4\mu$.

5. *Anthostomella sabalensioides* Ellis & Martin

Ellis J. B. Amer. Nat. 16, 810 (1882). Ellis J. B. & B. M. Everhart N. Amer. Pyren. 421, (1892).

Stromata discoid to irregular, evident externally as a carbonaceous matrix with up to 6 perithecia, $0.3-1.5 \times 0.3-5.0 \times 0.3-0.5$ mm. Ectostroma scanty, submersed in wood. Entostroma slight; outer part carbonaceous, black, basal tissue corky, dull brown to black. Perithecia vaguely evident to immersed,

oval, $300-400 \times 400-600\mu$; ostioles short, medium papillate or indistinct. Asci cylindric, $75-115 \times 7-10\mu$; stipes very short, $7-18\mu$. Spores elliptic, each with a short obtuse appendage on the proximal end; other end broad or narrow; dark brown, $3.5-7.5 \times 10.5-15.5\mu$, ave. $5.2 \times 13.0\mu$.

Hosts: Apparently restricted to woody monocotyledons, including *Sabal*.

Material examined:—

Calkins in Ellis & Everhart's North Amer. Fungi 1964; on *Sabal serrulata*, Florida, U.S.A., (1887), (NYBG). Martin 1750 ex Carroll 90; on *Smilax*, Quetzaltenango, Guatemala, (1962). Martin 1804 ex Carroll 577; Rivercrest, Austin, Texas, U.S.A., (1963).

Cultural characters (Plate II:10):—

Colonies felty to floccose, pure white, dry to gelatinous in aspect, growing freely with fine texture. Mycelial aggregates absent. Growth is partly zonate with 1 or 2 zones developed in each colony. Margin distinct, narrow but distinctly lobed; hyphae compact. Conidia produced when old and not conspicuous. Stain and carbonization absent. Growth rate very slow, 0.7 mm/day at 25°C .

Microscopic characters:—

Primary mycelium not diagnostic; maximum diameter of marginal hyphae = 1.8μ . Secondary mycelium absent.

Conidiophores and conidia:—sterile.

REFERENCES

- MARTIN, P. 1967. "Studies in the Xylariaceae I". *Jl S. Afr. Bot.* **33**: 205-240.
 MILLER, J. H. 1928. "Biologic studies in the Sphaerales II". *Mycologia* **20**: 305-339.
 NITSCHKE, T. 1867. *Pyrenomycetes Germanici* **I**: 110. Breslau.
 PETRAK, F. 1923. "Mykologische Notizen". *Annales Mycol.* **21**: 252-255.
 SACCARDO, P. A. 1877-1886. *Fungi Italici autographice delineati*, p. 161 et seq., Franzani, Patavii.
 SHEAR, C. L. 1938. Mycological Notes II. *Mycologia* **30**: 580-593.
 TRAVERSO, J. B. 1906. *Flora Italica Cryptogamia* **I**. Fungi. Casciano, Cappelli.
 WEHMEYER, L. E. 1926. "A Biologic and Phylogenetic study of the Stromatic Sphaerales". *Amer. Jour. Bot.* **13**: 575-645.

